

Application Ser. No. 10/787,037 ,
Applicant: A. Sugiyama

Attorney Docket No. 60896 (70551)
Art Unit: 1763

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REMARKS

This is in response to the Office Action dated January 22, 2008, currently outstanding with respect to the above-identified application. Claims 1 and 3-12 are pending in the application. Claims 1 and 3-12 are rejected.

Claim 1 is herein amended to recite that the gas exhausting means is provided through the inside of only the second of the two recited electrodes. That structure is supported throughout the specification and the drawings of the application as filed. The gas is always exhausted only through the second electrode. Never is the gas which is exhausted through the second electrode also allowed to pass through the first electrode, or, in those cases where there is a third electrode having the same polarity as the first, through that third electrode. As disclosed, this gives the advantage that, even if unspent reactive gas exists in the exhaust means, there is no difference in potential within the exhaust means, so plasma formation or abnormal discharge will not occur within the exhaust means. See, e.g., Page 4, line 32 to Page 5, line 9, and Figs. 1, 5, 6, and 10-13 of the application as filed.

Claim 1 recites two electrodes, and the amendment recites that the gas supplying means goes through only the first electrode of the first and second electrodes, and that the gas exhausting means goes through only the second of the first and second electrodes. The claim is drafted to focus on the relationship of the first and second electrodes, so that the addition of a third electrode, as in claim 12, does not change that relationship. Thus claim 1 remains a proper independent claim from which claim 12 may depend. Applicants make this amendment without prejudice to pursuing the original subject matter of this application in a later filed application claiming benefit of the instant application, including without prejudice to any determination of equivalents of the claimed subject matter. Support for the amendments can be found throughout the application as filed. No new matter has been added.

Claim 7 has been amended to recite that the exhaust opening is located at the recessed portion of the second opposing surface. This amendment is supported in each of the disclosed embodiments wherein there is a recessed portion of the second opposing surface, e.g., Figs. 6 -

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13, and, for example, at page 19, lines 1-10 of the application as filed. No new matter has been added.

Applicants respectfully request reconsideration of the above-identified application, and allowance of the claims as amended. Applicants respectfully submit that the application is patentable over the art relied upon by the Examiner, and that all claims are now in condition for allowance. Should the Examiner disagree, Applicants respectfully request the Examiner to contact their undersigned representative by telephone so that an interview may be scheduled prior to the mailing of any Advisory Action.

Claim Rejections- 35 U.S.C. § 103(a)

Ebata et al. in view of Tamura

Claims 1, 3-6, 8-10 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,406,590 to Ebata et al. ("Ebata") in view of U.S. Patent No. 5,948,165 to Tamura ("Tamura").

Claim 1

The Office Action states that Ebata discloses a plasma processing apparatus generating plasma under atmospheric pressure for processing an object as shown in Fig. 9 of Ebata. Viewed in conjunction with Fig. 1, Ebata et al. disclose a plasma processing apparatus for processing an object (J) comprising a cylindrical first (6) electrode encircling an opposite polarity second (5) electrode. A gas supply system (R)¹ extended via gas supply path (1) through electrode 6 to supply openings (2). A gas exhaust system (E), extended from exhaust opening (4) through a portion of the second electrode (5), through the dielectric (11), and thence through first electrode (6) to discharging path (3).

¹ The Office Action description inadvertently switched the supply system (R) for the exhaust system, (E) of Ebata et al.

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That is an important difference from the systems of the present invention as defined by the present claims, and as originally disclosed. In the present invention, the exhaust gas exits only through the second electrode, and is never again exposed to the polarity of the first electrode. Thus plasma in the claimed invention is formed only at the surface of the object to be treated. In the device of Ebata et al., any unreacted gas passing through the exhaust path from the second electrode to the first electrode would be again exposed to the plasma-inducing potential difference between the first and second electrodes. Thus in Ebata et al., unlike the present invention, plasma may be generated or abnormal discharge may occur in the discharge path due to the potential difference between inner electrode 5 and outer electrode 6.

In the present invention, since the exhaust gas passes through only one electrode, the potential to which it is exposed remains the same. Thus even when unreacted processing gas exists in the gas exhausting means, neither plasma nor abnormal discharge is formed. See, e.g., Page 4, line 32 to Page 5, line 9:

Preferably, the gas supplying means is provided inside the first electrode, and the gas exhausting means is provided inside the second electrode. In the plasma processing apparatus structured in this manner, the potential is the same inside the first and second electrodes, and therefore, even when processing gas exists in the gas supplying means and the gas exhausting means, plasma or abnormal discharge does not occur. Therefore, power applied to the first and second electrodes can be utilized efficiently for generating plasma at the surface of the object. Further, the size of the apparatus can be reduced as compared with an apparatus having the gas supplying means and the gas exhausting means provided outside the electrodes.

Although the Office Action acknowledged that Ebata et al. did not teach the first and second electrodes having coated surfaces with the dielectric covering the coated surfaces, the Office Action stated that "Tamura teaches the provision of an intermediate layer between an electrode and a dielectric for the purpose of joining the electrode and the dielectric and for the purpose of providing a material having extendability for absorbing thermal deformation of either of the two." The Office Action concluded that

[i]t would have been obvious to one of ordinary skill in the art at the time the Applicant's invention was made to have provided an

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intermediate coating layer on the electrode surfaces and between the dielectric and the electrode in order to join the electrode and the dielectric and in order to provide a material extendability for absorbing thermal deformation of either of the two as taught by Tamura.

(Office Action, para. 6).

It is submitted that Tamura merely discloses placing an intermediate layer between an electrode and a dielectric. Tamura nowhere discloses or suggests passage of the exhaust gases only through the second electrode to isolate them from re-exposure to the potential difference between the electrodes, as in the disclosure of Ebata et al. Thus Tamura neither teaches nor suggests in any way a solution to the problem caused by the structures taught by Ebata et al.

Moreover, incorporating the teachings of Tamura fail to cure the deficiencies of Ebata in attempting to render the claims of the instant invention obvious. Tamura disclosed nothing about coating an electrode used to generate a plasma. The electrode Tamura dealt with was only for "chucking" i.e., holding, the item to be treated in a chamber where other electrodes, which are not so coated, create the plasma which treats the target item. Tamura's chucking electrode did not generate plasma, but merely electrostatically held the target item and attracted ions from the plasma towards the target item.

Tamura disclosed an intermediate layer between the chucking electrode and a dielectric block composed of indium, acting to "absorb thermal expansion distortion caused by the thermal expansion coefficient difference between the dielectric block 2 and the electrode body 1." (Tamura, col. 5, ll. 6-10). It "eases thermal stress distortion" and avoids "cracking of the dielectric block 2 caused formerly by adopting fixing screws..." (Tamura, col. 5, ll. 13-15). It also improves thermal conductivity between the electrode body and the dielectric block. (Tamura, col. 5, ll. 21-23). Tamura was concerned only with providing a strong chucking effect that would hold the target item in the treating plasma, which was otherwise generated. Tamura made no attempt to suggest application of such an intermediate layer to plasma-generating electrodes.

In contrast, the coated surfaces of the electrodes in the instant application define the portion of the electrodes involved in the generation of plasma and in the processing of the

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substrate. By having the dielectric cover the coated surfaces, plasma discharge is not concentrated at a portion where the first and second electrodes are closest to each other. (see, e.g., Specification at para. 0016, 0018, 0021, 0050, 0074 0086 and 0087).

Therefore, neither Ebata nor Tamura, either separately or in combination, would have rendered the claims of the instant applications obvious at the time this invention was made. For the foregoing reasons, Applicants respectfully request reconsideration of the rejection of claim 1, because it is patentable over the references cited.

Claims 3-6, 8 and 12

With respect to claims 3, 4, 5, 6, 8 and 12, the Office Action states or implies that Ebata teaches the limitations of those dependent claims. Applicants respectfully traverse. The gas exhausting means defined by claim 1 is inside the second electrode. The gas exhausting means in Ebata extends through both the second and the first electrodes, and has no dielectric wall which surrounds it or is effective to prevent exposure of the exhaust gas to the change in potential as it passes from the second to the first electrode. Nothing in Ebata suggests changing its system to achieve such a wall, in the absence of hindsight from the present disclosure. With regard to claim 4, the fact that the coated surface 8 happens to be parallel to the body to be treated is irrelevant, since it does not relate to any electrode which is used to generate the plasma to which the body is exposed. The plasma-generating electrodes in power supply mechanism 104 of Tamura are far removed from, and clearly not parallel to the surface of, the target item. Tamura's system is radically different from the present system, and makes no reasonable suggestion of the invention of claim 4. At any rate, Claims 3-6, 8 and 12 would not have been obvious for at least the reason that they depend from claim 1, which was clearly not disclosed or suggested by Ebata or Tamura, or any reasonable combination of the prior art of record, as noted above. Therefore, reconsideration and withdrawal of the rejections of these claims is respectfully requested.

Claim 9

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With respect to claim 9, the Office Action states that Ebata suggests "that it is ideal for any gas supplied into the processing region gas supplying means be exhausted from the processing region by the gas exhausting means, rather than by any other means." (Office Action, para. 12). Applicants respectfully traverse.

That conclusion is directly contrary to the teachings of the references of record. Ebata discloses an apparatus for generating plasma or reaction gas at high pressure, compared to the low pressure, preferably vacuum, in treatment chamber C. See Fig.1, and note that Discharge device E pulls gas from two sources: the discharge path (3) and the unnumbered connection to chamber C which appears above the number 3 in Fig. 1. As shown best in Figs 3, 4 and 5, the reaction gas supply inlets 2 disburse the gas in all directions, not merely in the direction of the gas discharging outlet 4. That multidirectional dispersion of incoming gas is necessary to the effective operation of the Ebata device.

The ambient pressure in Chamber C is lower than the pressure between the face of the electrode and the target sample. (see, e.g., Ebata, col. 15, ll. 18-24). It is important for the gas flow path to have a low conductance from the high-pressure gas supply to the ambient atmosphere (see, e.g., Ebata, col. 16, ll. 4-9). The electrode assembly of Ebata is moveable, and the gap between the electrode and the target sample is a function of the high pressure of the reaction gas being fed to the space between the floating electrode and the sample being treated, the weight of the electrode, and the degree of low pressure or vacuum present in the reaction container. (see, e.g., Ebata col. 25, ll. 58-61). The difference in pressure between the treatment area and the reaction container, and the low conductance path created by the gap are also important in keeping the electrode "from being tilted with respect to the sample..." (see, e.g., Ebata, col. 37, ll. 26-30). Therefore, the processing gas necessarily must flow under high pressure in directions both toward and away from the exhaust port in order to create the gap and support the floating electrode. The gas which does not go through the discharging outlet 4 is exhausted from Chamber C by the Discharge device through the unnumbered exhaust fixture in Fig. 1. Ebata clearly fails to teach gas supplying means and said gas exhausting means formed

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such that total flow rate of gas exhausted through the exhaust opening is not smaller than total flow rate of the processing gas supplied through the supply opening, as recited in claim 9.

Claim 10

With respect to claim 10, the Office Action implies that the general conditions of claim 10 are disclosed in Ebata, and states that Ebata teaches that the number and position of the supply openings and exhaust openings can be tailored as needed. Applicants respectfully traverse.

Ebata in fact does not disclose the general conditions of claim 10 of the instant application. As described in paragraphs 78-82 of the instant application, the relation of $4 \leq L1/L2 \leq 1000$ and $4 \leq L3/L2 \leq 1000$, as recited in claim 10, increases the efficiency with which the processing gas can be delivered to the gas exhaust opening. As discussed above, Ebata discloses an apparatus in which the processing gas necessarily must flow under high pressure in directions both toward and away from the exhaust port in order to create the gap and support the floating electrode. Nothing in Ebata suggests even the possibility of having dimensions of the structures of and between the supply and exit ports which would increase efficiency of the treatment of the target object. Claim 10 is therefore nonobvious over Ebata, and reconsideration and withdrawal of the rejection of claim 10 is respectfully requested.

Claim 7

Claim 7 is rejected under 35 U.S.C. §103(a) as being unpatentable over Ebata in view of Tamura and U.S. Patent Application Pub. No. 2003/0213561 to Selwyn et al. ("Selwyn"). The Office Action states that Ebata and Tamura fail to disclose a dielectric including a recessed portion formed such that the distance from the surface of the object to the second opposing surface is larger than the distance from the surface of the object to the first opposing surface. The Office Action further states that Selwyn teaches the provision of recesses (grooves) of varied placement, number, size and shape, as desired, on the surface of an electrode for the purpose of controlling the density, or aggressiveness of plasma chemistry. The Office Action states that it would have been obvious to provide recesses or grooves on the surface of the dielectric covered

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electrode of Ebata "in order to control the density, or aggressiveness of plasma chemistry as taught by Selwyn et al." Applicants respectfully traverse.

Selwyn discloses optional "grooves" cut into the electrode to affect plasma ion density or "aggressiveness" of processing, with the gentlest processing being associated with an electrode having no grooves. (Selwyn, para. 0041). The grooves are alleged to induce an increased ion bombardment rate, as evidenced "by the presence of a brighter emission region directly below each of the grooves, indicating a more dense plasma." (Selwyn, para. 0056). Selwyn fails to teach an indented portion or recess in a dielectric at the position of the second opposing surface to increase the conductance of the processing gas.

In contrast, claim 7 of the instant application recites a dielectric including a recessed portion formed such that the distance from the surface of the object to the second opposing surface is made larger than the distance from the surface of the object to the first opposing surface. By forming an indented or recessed portion that increases the distance from the second opposing surface to the surface to be processed, the conductance of the processing gas on the side of the gas exhaust opening can be significantly increased. (see, e.g., Specification para. 0099). This structure facilitates movement of the processing gas toward the plasma generating region and thence to the gas exhaust opening. (see, e.g., Specification para. 0100). This feature is neither taught nor suggested by Selwyn, either alone or in combination with Ebata and Tamura. Moreover, Claim 7 as presently amended, recites that the exhaust opening is located at the recessed portion of the second opposing surface. As noted above and in, e.g., paragraph 99 of the original application, that has a substantial effect on the movement of the exhaust gas. Nothing in any of the references suggest such a structure or such a result. Therefore, the cited references fail to render claim 7 of the instant application obvious. Reconsideration and withdrawal of the rejection of claim 7 is respectfully requested.

Claim 11

Claim 11 is rejected under 35 U.S.C. §103(a) as being unpatentable over Ebata and Tamura as applied to claims 1, 3-6, 8-10 and 12, and further in view of U.S. Patent No. 5,198,724 to Koinuma et al. ("Koinuma"). The Office Action states that Koinuma teaches

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providing a grounded conductive cover to cover externally exposed surfaces of first and second electrodes of a plasma processing apparatus. However, Koinuma fails to remedy any of the failures of the other references. Accordingly, Claim 11 would not have been obvious for at least the reasons that the invention of claim 1 would not have been obvious, as noted above. Therefore, reconsideration and withdrawal of the rejection of claim 11 is respectfully requested.

CONCLUSION

In view of the above amendment and Remarks, Applicants believe the pending application is in condition for immediate allowance. Should any of the claims not be found to be in condition for allowance, the Examiner is requested to call Applicants' undersigned representative so that an interview can be arranged concerning the application. Applicants thank the Examiner in advance for this courtesy.

Applicants believe that no fee is due to consider the present amendment. Nevertheless, the Director is hereby authorized to charge or credit any deficiency in the fees filed, asserted to be filed or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Deposit Account No. 04-1105.

Respectfully submitted,

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